

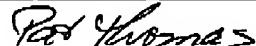
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Chu-Chung Lee et al. Group Art Unit: 2815
 Application No.: 10/682,541 Examiner: Jasmine Jhihan B. Clark
 Date Filed: September 15, 2003 Docket No.: SC12481TK
 Title: INTEGRATED CIRCUIT DIE HAVING A COPPER CONTACT AND METHOD
 THEREFOR

Certificate of Transmission under 37 CFR 1.8

I hereby certify that this correspondence is being facsimile transmitted to the Patent and Trademark Office.

on 1-13-05



Signature

Pat Thomas

Printed Name of Person Signing Certificate

INFORMATION DISCLOSURE STATEMENT (IDS)

Commissioner For Patents
 P.O. Box 1450
 Alexandria, VA 22313-1450

SIR:

In accordance with 37 C.F.R. §1.56 and in compliance with 37 C.F.R. §§1.97 and 1.98, the references listed on attached Form PTO/SB/08 and/or subsequently identified herein, are being submitted herewith for consideration by the United States Patent and Trademark Office. The Office hereby waives the requirement under 37 CFR 1.98 (a)(2)(i) for submitting a copy of each cited U.S. patent and each U.S. patent application publication for all U.S. national patent applications filed after June 30, 2003 and for all international applications that have entered the national stage under 35 USC § 371 after June 30, 2003. See 37 CFR 1.491(b).

I. COPIES

- a. A legible copy of (i) each U.S. and foreign patent; (ii) each publication or that portion which caused it to be listed; and (iii) all other information or that portion which caused it to be listed, is included herewith.
- b. Any patents, publications or other information which are listed on PTO/SB/08 which are not enclosed herewith were previously cited by or submitted to the PTO in one of the following applications which has been relied upon for an earlier filing date under 35 U.S.C. §120:

U.S. Serial Number

U.S. Filing Date

II. CONCISE EXPLANATION OF THE RELEVANCE (check at least one box)

- a. Except as may be indicated below in (b) of this section, all of the patents, publications or other information are in the English language (concise explanation not required).
- b. A concise explanation of the relevance of all patents, publications or other information listed that is not in the English language is as follows:
- c. The following additional information is provided for the Examiner's consideration:

III. CROSS REFERENCE TO RELATED APPLICATION(S)

The Examiner is advised that the following co-pending application(s) contain(s) subject matter that may be related to the present application. By bringing this (these) applications to the Examiner's attention, Applicant(s) does(do) not waive the confidentiality provisions of 35 U.S.C. §122.

Serial No.Filing DateArt UnitFEES

- IV. THIS IDS IS BEING FILED UNDER 37 C.F.R. §1.97(b): (check one box)
- a. within three months of the filing date of a national application other than a continued prosecution application under § 1.53(d) (37 C.F.R. §1.97(b)(1)). No fee or statement is required.
- b. within three months of the date of entry of the national stage as set forth in § 1.491 in an international application (37 C.F.R. §1.97(b)(2)). No fee or statement is required.
- c. before the mailing date of a first Office Action on the merits (37 C.F.R. §1.97(b)(3)). No fee or statement is required.
- d. before the mailing date of a first Office Action after the filing of a request for continued examination under § 1.114 (37 C.F.R. § 1.97(b)(4)). No fee or statement is required.
- V. THIS IDS IS BEING FILED UNDER 37 C.F.R. §1.97(c): (check one box)
- before the mailing date of any of a Final Office Action under 37 C.F.R. §1.113, a Notice of Allowance under 37 C.F.R. §1.311, or an action that otherwise closes prosecution in the application (See 37 C.F.R. §1.97(c)).
- a. No statement; therefore, charge Deposit Account 503079, Freescale Semiconductor, Inc. the fee set forth in 37 C.F.R. §1.17(p).
- b. See the statement below. No fee is required.
- VI. THIS IDS IS BEING FILED UNDER 37 C.F.R. §1.97(d):
on or before payment of the issue fee and is accompanied by the following:
- 1) a statement under 37 C.F.R. §1.97(e) as provided below; and
 - 2) charge Deposit Account 503079, Freescale Semiconductor, Inc. the petition fee set forth in §1.17(p).
- VII. STATEMENT UNDER 37 C.F.R. §1.97(e) (check only one box, if applicable)
The undersigned hereby states that
- a. each item of information contained in the IDS was cited in a communication from a foreign Patent Office in a counterpart foreign application not more than three months prior to the filing of IDS; or
- b. no item of information contained in the IDS was cited in a communication from a foreign Patent Office in a counterpart foreign application, and to knowledge of the person signing the statement after making reasonable inquiry, no item of information contained in the IDS was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement, or
- c. some of the items of information contained in the IDS were cited in a communication from a foreign Patent Office. As to this information, the undersigned states that each item of information contained in the IDS was cited in a communication from a foreign Patent Office in a counterpart foreign application not more than three months prior to the filing of this IDS. As to the remaining information, the undersigned hereby states that no item of this remaining information contained in the IDS was cited in a communication from a foreign Patent Office in a counterpart foreign application or, to the knowledge of the person signing the statement after making reasonable inquiry, no item of information contained in the IDS was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this statement.

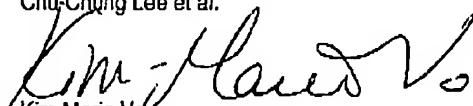
PAYMENT OF FEES

- A check in the amount of _____ is enclosed for the above-identified fee(s).
- Please charge Deposit Account No. 503079, Freescale Semiconductor, Inc. in the amount of \$180.00 for the above-indicated fee(s).
- If Applicant has overlooked any additional fees, or if any overpayment has been made, the Commissioner is hereby authorized to credit or debit Deposit Account 503079, Freescale Semiconductor, Inc.
- Two Copies of this paper are attached for Deposit Account charges and debits.

The above references are being cited only in the interests of candor and without any admission that they constitute statutory prior art or contain matter which anticipates the invention or which would render the same obvious, either singly or in a combination, to a person of ordinary skill in the art.

If the Examiner has any questions concerning this IDS, he/she is requested to contact the undersigned. If it is determined that this IDS has been filed under the wrong rule, the PTO is requested to consider this IDS under the proper rule (with a petition if necessary) and charge the appropriate fee to Deposit Account No. 503079, Freescale Semiconductor, Inc.

Respectfully submitted,
Chu-Chung Lee et al.



Kim-Marie Vo
Agent for Applicant(s)
Reg. No. 50,714
Tel. (512) 996-6839

FREESCALE SEMICONDUCTOR, INC.

Customer Number 23125

Enclosures:



- PTO/SB/08
References
Other:
Internal Search Report & Written Opinion

X

Please type a plus sign (+) inside this box.

Substitute for form 1449A/PTO				<i>Complete If Known</i>	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Application Number	10/682,541
				Filing Date	September 15, 2003
				First Named Inventor	Chu-Chung Lee et al.
				Group Art Unit	2815
				Examiner Name	Jasmine Jhlhan B. Clark
Sheet	1	of	1	Attorney Docket Number	SC12481TK

U. S. PATENT DOCUMENTS

FOREIGN PATENT DOCUMENTS

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS

Examiner: Initials*	Cite No. 1	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²

Examiner Signature		Date Considered	
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 608. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ Unique citation designation number. ² Applicant is to place a check mark here if English Language Translation is attached.

**PATENT COOPERATION TREATY
PCT**

**INTERNATIONAL SEARCH REPORT
(PCT Article 18 and Rules 43 and 44)**

Applicant's or agent's file reference SCI2481TK	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCTUS04/09816	International filing date (day/month/year) 31 March 2004 (31.03.2004)	(Earliest) Priority Date (day/month/year) 02 April 2003 (02.04.2003)
Applicant MOTOROLA		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

I. Basis of the Report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing:

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. Certain claims were found unsearchable (See Box I).

3. Unity of invention is lacking (See Box II).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. 2

as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

None of the figures

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US04/09816

A. CLASSIFICATION OF SUBJECT MATTER

X. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : H01L 23/48, 23/52, 29/40
US CL : 257/762, 786, 773, 784, 758, 759, 767; 438/687, 681, 622

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHER

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 257/762, 786, 773, 784, 758, 759, 767; 438/687, 681, 622

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,610,601 B2 (Li et al.) 26 August, 2003 (26-08-2003), Col. 1-10	I-39
Y		
Y	US 6,380,626 B1 (Jiang) 30 April 2002 (30-04-2002), Col. 3-6	I-39
Y	US 4,821,148 (Kobayashi et al.) 11 April 1989 (11-04-1989), Col. 3-6	I-39
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Further documents are listed in the continuation of Box C.

1

See patent family annex.

* Special categories of cited documents:

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"A" document defining the general state of the art which is not considered to be of particular relevance

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

Date of the actual completion of the international search

Date of mailing of the international search report

06 July 2004 (06.07.2004)

28 DEC

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Authorized officer
Eddie Lee
Telephone No. 703-306-3431

Form PCT/ISA/210 (second sheet) (July 1998)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
PATRICIA S. GODDARD
CORPORATE LAW DEPARTMENT
INTELLECTUAL PROPERTY SECTION
7700 WEST PARMER LANE, MD: TX32/PL02
AUSTIN, TX 78729

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

		Date of mailing (day/month/year) 28 DEC 2004
Applicant's or agent's file reference SC12481TK		FOR FURTHER ACTION See paragraph 2 below
International application No. PCT/US04/09816	International filing date (day/month/year) 31 March 2004 (31.03.2004)	Priority date (day/month/year) 02 April 2003 (02.04.2003)
International Patent Classification (IPC) or both national classification and IPC IPC(7): H01L 23/48, 23/52, 29/40 and US Cl.: 257/762, 786, 773, 784, 758, 750, 767; 438/687, 681, 622		
Applicant MOTOROLA		

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.
For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ US Mail Stop PCT, Attn: ISA-US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Authorized officer Eddie Lee <i>E. Eddie Lee</i> Telephone No. 703-306-3431
--	--

Form PCT/ISA/237 (cover sheet) (January 2004)

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US04/09816

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material

a sequence listing
 table(s) related to the sequence listing
 - b. format of material

in written format
 in computer readable form
 - c. time of filing/furnishing

contained in international application as filed.
 filed together with the international application in computer readable form.
 furnished subsequently to this Authority for the purposes of search.
3. In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITYInternational application No.
PCT/US04/09816

Box No. V Reasoned statement under Rule 43 bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims <u>4,8,9,11,15,18,19,21 and 27-38</u>	YES
	Claims <u>1-3,5-7,10,12-14,16,17,20,22-26 and 39</u>	NO
Inventive step (IS)	Claims <u>1-3,5-7,10,12-14,16,17,20,22-26 and 39</u>	YES
	Claims <u>4,8,9,11,15,18,19,21 and 27-38</u>	NO
Industrial applicability (IA)	Claims <u>1-39</u>	YES
	Claims <u>NONE</u>	NO

2. Citations and explanations:

Please See Continuation Sheet

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

<p>Supplemental Box In case the space in any of the preceding boxes is not sufficient.</p>	<p>International application No. PCT/US04/09816</p>
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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

V. 2. Citations and Explanations:

1. Claims 1-3, 5-7, 10, 12-14, 16, 17, 20, 22-26 and 39 lack novelty under PCT article 33(2) as being anticipated by Li et al (US Pat. 6610601).

Regarding claims 1-3, 5-7, 10, 12-14, 16, 17, 20, 22-26 and 39, Li et al. disclose an integrated circuit (IC) die/device and a method of making such IC die/device comprising:

- forming a copper contact/pad (402 in Fig. 4E; Col. 5, lines 1-26) of the IC die or a plurality of such contacts/pads on a wafer, the copper contacts being a wire bond copper pads
- pretreating the copper contact with an acid solution (Col. 4, lines 10-33)
- forming a coating on the copper contact by exposing the copper contact to an organic material/solution and a reaction of the organic solution with copper oxide (Col. 8, line 53; Col. 9, line 15)
- the organic material/solution comprising a variety of material from triazole family having molecules containing nitrogen-hydrogen bonds including benzotriazole/BTA having a pH of about 7.0 (Col. 8, line 55- Col. 9, line 17; Col. 10, lines 23-43), the BTA coating having a thickness of about 20 angstroms or less by dipping a wafer for a predetermined time amount (Col. 6, lines 40-45; Col. 10, lines 13-18)
- forming a wire bond on the copper pad (see Fig. 4F), the wire bonding removing a portion of the coating directly under the wire (Fig. 4A-4E; Fig. 1-4; Col. 1-11).

2. Claims 4, 21 and 27 lack inventive step under PCT article 33(3) as being obvious over Li et al. (US pat. 6610601).

Regarding claims 4, 21 and 27, Li et al. teach substantially the entire claimed structure and the method as applied to claims 1 and 16 above, except the solution having the pH of at least 7.5 or dipping the wafer for about 5 minutes.

The parameters such as pH of the solution, rinse/coating time, roller/brush speed, drying time, etc. in coating application in chip packaging and interconnect technology is a subject of routine experimentation and optimization to achieve the desired coating density, thickness and quality. It would have been obvious to one of ordinary skill in the art to select the pH of about 7.5 or dipping the wafer for about 5 minutes so that the desired thickness and the quality of the coating can be achieved in Li et al's IC die.

3. Claims 8 and 9 lack inventive step under PCT article 33(3) as being obvious over Li et al. (US pat. 6610601) in view of Izumitani et al. (US Pat. 6727590).

Regarding claims 8 and 9, Li et al. teach substantially the entire claimed structure and the method as applied to claim 1 above, except a plurality of interconnect layers having the final copper layer (Col. 1, lines 61-65), but fail to teach an insulating layer overlying the interconnect layers such that the copper layer is accessible by an opening in the insulating layer.

Izumitani et al. teach a conventional interconnect structure having an insulating layer (see 72/73 in Fig. 22; Col. 18 and 19) overlying the interconnect layers to provide the desired surface protection. It would have been obvious to one of ordinary skill in the art to

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITYInternational application No.
PCT/US04/09816

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

incorporate the insulating layer having the opening as taught by Iizumitani et al. so that the desired surface protection can be achieved in Li et al's IC die.

4. Claims 11 and 15 lack inventive step under PCT article 33(3) as being obvious over Li et al. (US Pat. 6610601) in view of Kobayashi et al. (US Pat. 4821148).

Regarding claims 11 and 15, Li et al. teach substantially the entire claimed structure as applied to claim 1 above, except the coating having a thermal resistance of 100 deg. C or greater or the IC die being attached to a packaged substrate respectively.

Kobayashi et al. teach conventional BTA coating having a thermal stability/resistance at a temperature of 120 deg. C (Col. 6, line 25; Col. 5 and 6). Kobayashi et al. further teach the IC die being attached to a packaged leadframe substrate (see Fig. 1A). It would have been obvious to one of ordinary skill in the art to incorporate the BTA having thermal resistance of 100 deg. C and the IC die being attached to the packaged substrate as taught by Kobayashi et al. so that the desired reliability and substrate configuration can be achieved in Li et al's IC die.

5. Claim 18 lacks inventive step under PCT article 33(3) as being obvious over Li et al. (US Pat. 6610601) in view of Test et al. (US Pat. 6268662).

Regarding claim 18, Li et al. teach substantially the entire method as applied to claims 16 and 26 above, but fail to teach the wire bonding being performed at 100 deg. C or above.

Test et al. teach an interconnect structure where a conventional wire bonding is performed at around 150-270 deg. C (see Col. 6, lines 16-35). It would have been obvious to one of ordinary skill in the art to incorporate the wire bonding being performed at 100 deg. C or above as taught by Test et al. so that the wire bonding defects can be reduced in Li et al's IC die.

6. Claims 19, 28, 29 and 31-38 lack inventive step under PCT article 33(3) as being obvious over Li et al. (US Pat. 6610601) in view of Wenzel (US Pat. 6230719).

Regarding claim 19, Li et al. teach substantially the entire method as applied to claims 16 and 26 above, but fail to teach performing plasma cleaning after forming the coating and before the wire bonding.

Wenzel teaches performing conventional cleaning steps including a plasma clean step (see Fig. 4 and 8; Col. 6, lines 38-67) to remove contamination on a bonding surface before performing the wire bonding. Wenzel further teaches using conventional gases such as argon, helium, etc. for the plasma cleaning (Col. 3, lines 63-66). It would have been obvious to one of ordinary skill in the art to incorporate the plasma cleaning process using the gases such as argon as taught by Wenzel so that the wire bonding defects can be reduced in Li et al's IC die.

Regarding claims 28, 29, 31-35, 37 and 38, Li et al. and Wenzel teach substantially the entire method as applied to claims 1-3, 5-7, 10 and 12-14, 16 and 19 above.

Regarding claim 36, Li et al. and Wenzel teach substantially the entire method as applied to claim 28 above, except singulating the die including the copper contact from a wafer before the plasma etching.

Wenzel teaches performing conventional singulating/dicing of a die from a wafer before performing conventional cleaning and bonding operations (see Fig. 6, 8, etc., Col. 5 and 6). It would have been obvious to one of ordinary skill in the art to incorporate the singulating process as taught by Wenzel so that cycle time can be improved and the wire bonding defects can be reduced in Wenzel and Li et al's IC die.

7. Claim 30 lacks inventive step under PCT article 33(3) as being obvious over Li et al (US Pat. 6610601) in view of Test et al. (US Pat. 6268882) and Wenzel (US Pat. 6230719).

Regarding claim 30, Li et al., Wenzel and Test et al. teach substantially the entire method as applied to claims 28, 1 and 18 above.